

(12) **UK Patent Application** (19) **GB** (11) **2 285 907** (13) **A**

(43) Date of A Publication 02.08.1995

(21) Application No 9505106.6

(22) Date of Filing 11.03.1992

Date Lodged 14.03.1995

(30) Priority Data

(31) 911008 (32) 14.03.1991 (33) NO

(62) Derived from Application No. 9318906.6 under Section 15(4) of the Patents Act 1977

(51) INT CL<sup>6</sup>

A23K 1/18

(52) UK CL (Edition N )

A2B BMA9 B821 B852 B866

(56) Documents Cited

EP 0292052 A2 DE 002903448 A1

(58) Field of Search

UK CL (Edition N ) A2B BMA9

INT CL<sup>6</sup> A23K 1/18

On-Line : WPI

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(54) **Feed for fish fry**

(57) A soft dry feed is especially for use as weaning feed for fry, at the transition from living feed to formulated feed. It consists of hard roe-like agglomerated particles, which are made of milled or ground fish meal having an average particle size below 50 µm a fat, a bonding agent, and optionally vitamins and minerals. The feed has a water content of below 14% by weight.

GB 2 285 907 A

"Feed for Fish Fry"

This invention relates to feed for fish fry. It is concerned with soft dry feed, especially a weaning feed, for use for fry at the transition from living feed to formulated  
5 feed.

The breeding of salmon and trout has gone on in Norway for many years, and such breeding has become a significant industry. In recent years there has also been interest in the breeding of types of marine fish, which can only live  
10 in sea water, such as halibut, turbot and cod. The problems with the feeding of larvae and fry of such kinds of marine fish are however substantially greater than the problems with the feeding of larvae and fry of salmon and trout.

Fry of halibut and other types of marine fish are  
15 initially fed with edible animals, such as artemia, cress and rotatoria. After a period of feeding with living feed, one can go over to a formulated feed, which in the trade is often called weaning feed.

Our co-pending Application No. 9318906.6 is concerned  
20 with feed and a process for the production of it for the first stage. This Application is concerned with the second stage.

According to the present invention there is provided soft dry feed, especially for use as weaning feed for fry at  
25 the transition from living feed to formulated feed, having a water content of less than 14% by weight and optionally containing vitamins and minerals having a particle size of 0.2-1.5 mm, characterised in that it consists of hard roe-

like agglomerated particles made of milled or ground fish meal having an average particle size ( $d_{50}$ ) of below 50  $\mu\text{m}$ , fat in an amount of 15-35% by weight, and bonding agent.

Preferably the particle size will be in the range 0.2 -  
5 1.5 mm.

Conveniently the bonding agent is in the form of a glue water concentrate which forms a gel on cooling down to a temperature in the region from  $+2^{\circ}\text{C}$  to  $+4^{\circ}\text{C}$ .

When halibut fry or other marine types are to be weaned  
10 from feeding with edible animals at the fry stage, specific requirements must be placed on the weaning feed, particularly from the type and development stage. That is to say the weaning feed ought to have the correct content of protein, fat and carbohydrate, have a correct mineral and vitamin  
15 content, have a suitable particle size, and the particles ought to be soft and free of sharp particles, which can damage the digestive system. Furthermore the particles ought to retain their shape during feeding, give the desired low leakage to the surroundings and have a satisfactory speed of  
20 sinking.

With the starting point in the enriched feed such as that forming the subject of Application 9318906.6, a soft dry feed was produced which satisfied the aforementioned requirements.

25 The feed consisted of the following ingredients:

a) milled or ground meal of corresponding type and quality as was employed for the enriched feed,

b) marine fat (cod liver oil and fish oils) or marine

fat combined with vegetable fat, .

c) vitamins and minerals,

d) glue water concentrate of high quality (is gel-forming in the region +2 to +4°C).

5 Tests were also made by mixing taste attractants, without this having a negative effect on the feed production.

With these ingredients several types of soft dry feed were produced containing less than 12% by weight water, 10 without carbohydrates, and in the form of hard roe-like particles of 0.2 - 1.5 mm magnitude.

Experimentally one found that the fat content in the feed could be varied freely in the region 15-35%. Furthermore it was found that when only raw fish oil is employed, 15 the content of free fatty acids ought to be lower than 1.5%.

The feed retained its shape in the breeding vessels and gave little leakage to the surroundings (10-20% by weight after 30 minutes in water).

From the experiments made it was demonstrated that 20 halibut fry in two breeding installations clearly preferred this feed over commercial weaning feed.

During the feeding the halibut fry snapped at the soft dry feed immediately, in contrast to commercial weaning feed which was spat out again several times before the halibut 25 fry finally managed to swallow it.

In order to achieve the desired particle form and softness there was employed a so-called agglomerating technique. It involves smaller particles being built up into

larger particles by means of cutting forces and bonding agents which are either supplied separately or which are present in the particles/powder.

Factors which have significance if one is to succeed  
5 with the agglomerating technique are as follows:

- Particle size and form for the primary particle  
versus the agglomerated particle
- Which bonding agents which are naturally present, or  
which must be supplied to the particles during the  
10 agglomerating
- How and with what strength the cutting forces are  
supplied to the powder material which is to be  
agglomerated.

Of known agglomerating methods rotating plates,  
15 rotating knives, and air/gas-whirling technique (fluidising)  
can be mentioned.

The most important supposition is that the choice of  
mode of milling or grinding, particle size and quality of  
meal and glue water concentration, together with the  
20 necessary amount of fat, yields an agglomerateable material,  
without the addition of foreign substances. This is achieved  
by preserving the natural collagens of the fish through the  
fish meal process.

Tests demonstrate that the agglomerated soft dry feed  
25 is reformable after mechanical loading. Deformation of the  
soft feed by pressure only required that one undertook a  
little stirring of the powder material, whereby the hard  
roe-like agglomerates were reformed.

The agglomerating technique functions better the finer the meal is milled or ground. It has been shown that powder with an average particle size,  $d_{50}$ , of over 50  $\mu\text{m}$  gave poorer agglomeration.

5        The advantages of using the soft dry feed, for example as weaning feed, can be summed up as follows:

- 10        - The halibut fry preferred the soft dry feed over commercial feed in experiments undertaken with two different breeders. Subsequent drying, which is necessary when using known feed products, yields harder particles, together with the danger of oxidising and/or interaction between fat and proteins. The soft dry feed on the other hand need not be subsequently dried.
- 15        - The survival and quality of the halibut fry proved to be very good with the breeder which employed the soft dry feed as weaning feed. The high survival achieved by halibut fry must be attributed to the quality of the feed. There were no sharp bone
- 20        particles in the feed, something which otherwise could damage the digestive system of the fry, and this can be one of the reasons for the high degree of survival.
- The feed included no carbohydrates.
- 25        - The fat became mixed into the feed at low temperatures.

With this the danger of the fat-protein interaction and oxidising could be reduced significantly.

It is important that the particle or particles, which the fry consume, must include the right nutrient substances. Viewed statistically an agglomerated particle of a finely milled or ground meal will include a richer selection of nutrients than a chance meal particle having the size of the agglomerate. Both types of particle will displace the same volume in the digestive system of the fry. The volume of the digestive system defines the feed intake of the fish fry.

CLAIMS

1. Soft dry feed, especially for use as weaning feed for fry at the transition from living feed to formulated feed, having a water content of less than 14% by weight and optionally containing vitamins and minerals having a particle size of 0.2-1.5 mm, characterised in that it consists of hard roe-like agglomerated particles and are made of milled or ground fish meal having an average particle size ( $d_{50}$ ) of below 50  $\mu\text{m}$ , fat in an amount of 15-35% by weight, and bonding agent.

2. Soft dry feed in accordance with Claim 1, characterised in that it has a particle size of 0.2 - 1.5 mm.

3. Soft dry feed in accordance with claims 1 or 2 characterised in that the bonding agent is in the form of a glue water concentrate which forms a gel on cooling down to a temperature in the region from +2°C to +4°C.



**Relevant Technical Fields**

(i) UK Cl (Ed.N) A2B (BMA9)

(ii) Int Cl (Ed.6) A23K 1/18

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Search Examiner  
**K J KENNETT**

Date of completion of Search  
**21 APRIL 1995**

Documents considered relevant following a search in respect of Claims :-  
**1-3**

**Categories of documents**

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|---|---|
| <b>X:</b> Document indicating lack of novelty or of inventive step.   | <b>P:</b> Document published on or after the declared priority date but before the filing date of the present application.        |
| <b>Y:</b> Document indicating lack of inventive step if combined with one or more other documents of the same category. | <b>E:</b> Patent document published on or after, but with priority date earlier than, the filing date of the present application. |
| <b>A:</b> Document indicating technological background and/or state of the art.   | <b>&amp;:</b> Member of the same patent family; corresponding document.   |

Category	Identity of document and relevant passages	Relevant to claim(s)
A	EP 0292052 A2 (SUOMEN SOKERI) whole document	1
A	DE 2903448 A1 (UNILEVER) abstract	1